Solid State Energy Conversion for Deep Space Power

Completed Technology Project (2015 - 2019)

Project Introduction

Thermophotovoltaic (TPV) devices employed in static radioisotope generators show great promise for highly efficient, reliable, and resilient power generation for deep space missions. Long-wavelength TPVs would require lower-temperature heat sources, leading to reduced thermal stress on equipment and a better harvesting of the thermal source spectrum. However, these devices demand new materials with smaller bandgaps, materials that cannot be grown due to miscibility gaps or have yet to be grown without debilitating crystalline defects. To increase the potential for TPV technologies, my research focuses on the epitaxial growth of III-V semiconducting compounds composed of bismuth for long-wavelength TPV applications, allowing for a greater ubiquity to heat harvesting and power generation systems. I will use both analytical and empirical tools to enable the success of my endeavor: modeling both global and local strain using Silvaco TCAD to understand the physics of the growth process, as well as fabricating samples by molecular beam epitaxy to compare theory with experiment. Ultimately, I will build and test a full TPV generator implemented with a graphite heat source to analyze our devices' potential efficiency in static radioisotope power sources. Long-wavelength, low-temperature TPVs hold the power to revolutionize electricity generation in a wide variety of fields by providing a clean, long-lasting, and efficient method of producing power.

Anticipated Benefits

Long-wavelength, low-temperature TPVs hold the power to revolutionize electricity generation in a wide variety of fields by providing a clean, long-lasting, and efficient method of producing power.

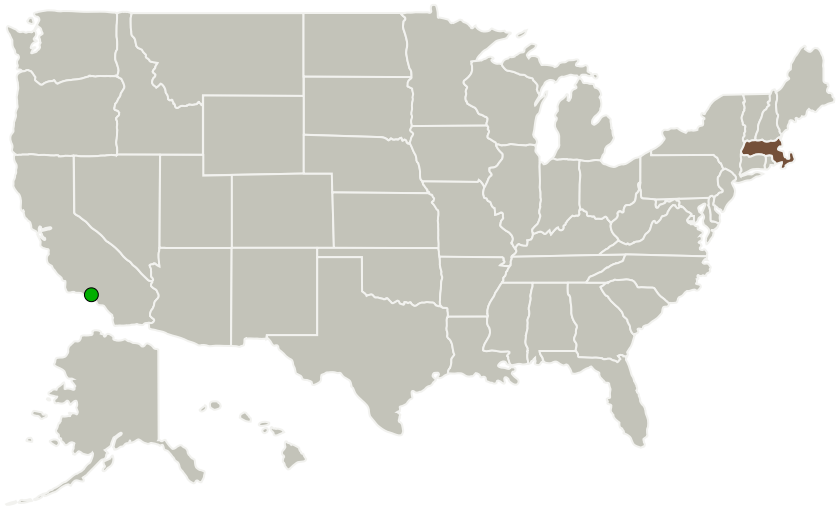
Solid State Energy Conversion for Deep Space Power

Table of Contents

Solid State Energy Conversion for Deep Space Power

Completed Technology Project (2015 - 2019)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Tufts University	Lead Organization	Academia	Medford, Massachusetts
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations
Massachusetts

Project Website:

https://www.nasa.gov/strg#.VQb6T0jJzyE

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Tufts University

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

Hung D Nguyen

Principal Investigator:

Thomas Vandervelde

Co-Investigator:

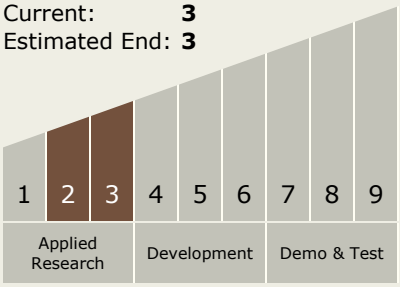
Margaret E Stevens

Solid State Energy Conversion for Deep Space Power

Completed Technology Project (2015 - 2019)

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX11 Software, Modeling, Simulation, and Information Processing
  - TX11.1 Software Development, Engineering, and Integrity
    - TX11.1.6 Real-time Software

Target Destination

The Moon